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HELHAT I

THE EFFECT OF OBSERVER POSITION ON TARGET DETECTION

John A. Barnes

March 1973
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HUMAN ENGINEERING LABORATORY

ABERDEEN PROVING GROUND, MARYLAND

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ABSTRACT

A flight experiment was performed to determine the effect of the observer's position in the helicopter on his ability to detect ordnance targets. The positions tested were: left seat, front seat and rear seat.

The 34 U. S. Army pilot subjects each flew two trial flights in opposite directions over a three-leg course at Coso Military Target Range, Naval Weapons Center, China Lake, California.

The results of the experiment showed no significant target detection performance differences that could be attributed to the observer's position in the helicopter.

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HELHAT I

THE EFFECT OF OBSERVER POSITION ON TARGET DETECTION

INTRODUCTION

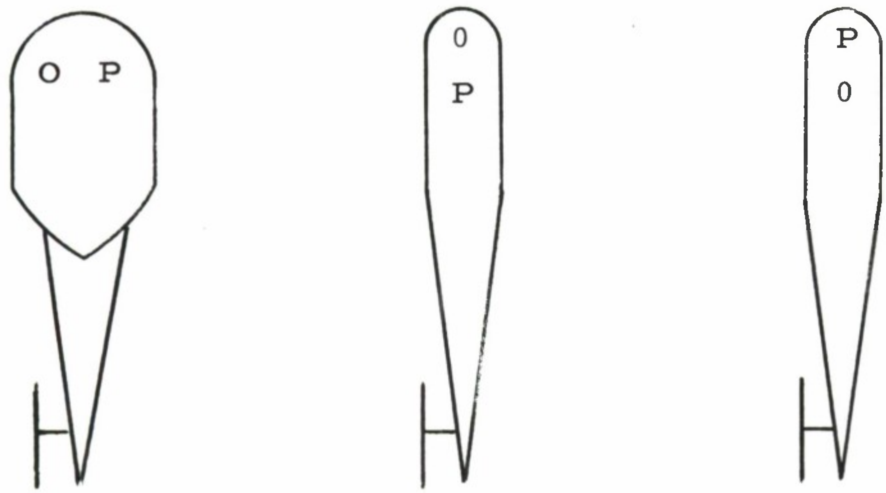
This report, the first in a series addressing the problem of air/ground target acquisition, deals with target detection as it is affected by the observer's position in the aircraft. There is some concern that the pilot/gunner arrangement in tandem seat helicopters such as the AH-1G may be reversed from the optimum as far as mission performance is concerned. The basis logic is compelling in: Nap-of-the-Earth (NOE) flight the pilot's principal concern is forward and downward, whereas the gunner/observers should be side-scanning. These primary visual tasks do not appear to be compatible with either the OH-58 side-by-side configuration or the AH-1G gunner forward tandem configuration.

Flight tests to examine these relationships were flown at the Coso Military Target Range of the Naval Weapons Center (NWC), China Lake, Cal., utilizing the OH-58 Kiowa and the AH-1G Cobra flown by combat returnee crews. The targets were military ordnance items of the 1950-1960 era. The flights were scheduled to be flown at altitudes of 100 feet or less but the radars were unable to track the aircraft at these lower altitudes because of the rough terrain; therefore, a base altitude of 100 feet was established and the flight legs were flown at altitudes from 100 feet to a maximum of 200 feet. The higher altitude gives the observer some advantage on certain targets, but when all of the scores are pooled this slight advantage appears to be absorbed.

The targets reported by each observer on each flight were analyzed to determine if the observer's position in the aircraft made any significant difference in the number of targets he reported. The observer positions were as shown in Figure 1. Each observer made two flights, one in each type of aircraft with the position and flight sequence determined by the experimental plan. This analysis indicated that there was no significant difference in the overall number of targets located that could be attributed to the aircraft. The statistical tests showed a significant relationship between the targets reported and the first and second run for the observer which indicated that the second flight, regardless of the position of the observer in the aircraft, should have produced a higher number of targets detected.

AIRCRAFT

LOH | COBRA 1 | COBRA 2



CONFIGURATION

Pilot Right	Observer Front	Pilot Front
Observer Left	Pilot Rear	Observer Rear

P - Pilot

O - Observer

Fig. 1. EXPERIMENTAL CONFIGURATIONS

METHOD

The experiment was initially designed to be done at Aberdeen Proving Ground, Md., but in view of logistical problems and the similarity of the U. S. Army Materiel Systems Analysis Agency-Naval Weapons Center test plan it was decided that by a modification of the original HELHAT plan (Appendix A) and a slight modification and extension of the U. S. Army Materiel Analysis Agency-Naval Weapons Center test plan all three agencies could combine their resources and secure the data that would essentially meet their experimental plans.

Of primary concern was the developing of a means to evaluate the oberser's positions and maintaining simplicity in both approach and instrumentation. The experiment was designed to measure three elements of target detection:

1. Number of targets detected.

2. Total.time consumed on the task.

3. Total time the helicopter was exposed to the target.

This report is concerned with the first of these elements.

The targets used were actual military ordnance of the 1950-1960 period, but the observers were not required to correctly identify the targets by official nomenclature; rather, they reported the clock position relative to their aircraft heading, a generic name for the target, and the estimated range in meters. The majority of the targets were painted in standard military camouflage greens and browns and showed a considerable amount of rust. Figures 2 through 10 show some of the targets seen by the observers while flying the designated legs.

At each target report a mark was made on the radar plot of the flight and a voice recording was made so that the experimenter had a written and a recorded description of each sighting by each observer. The actual targets to be scored were unknown to the observers so they were instructed to report all items of interest along their flight path as they would during an actual "Route Reconnaissance" type mission. This method also gave the measure of "clutter" for each observer as there was a considerable amount of ordnance debris along the flight course. Clutter was the total number of reported targets on a leg versus the number of scored targets reported on that leg. The targets used for scoring are described in Table 1. The target numbers listed are the numbers assigned to these targets by the Naval Weapons Center for the Coso Military Target Range.

Every observer flew two flights. On each flight he was seated in a different position in the aircraft and flew the course in a different direction than that of his first flight. There were 34 observer subjects and a total of 68 flights were flown. The flight order as planned was as follows:

1. Flight one, front seat of AH-1G; flight two, rear seat.

2. Flight one, rear seat of AH-1G; flight two, front seat.

3. Flight one, left seat of OH-58; flight two, rear seat of AH-1G.

4. Flight one, left seat of OH-58; flight two, front seat of AH-1G.

5. Flight one, front seat of AH-1G; flight two, left seat of OH-58.

6. Flight one, rear seat of AH-1G; flight two, left seat of OH-58.

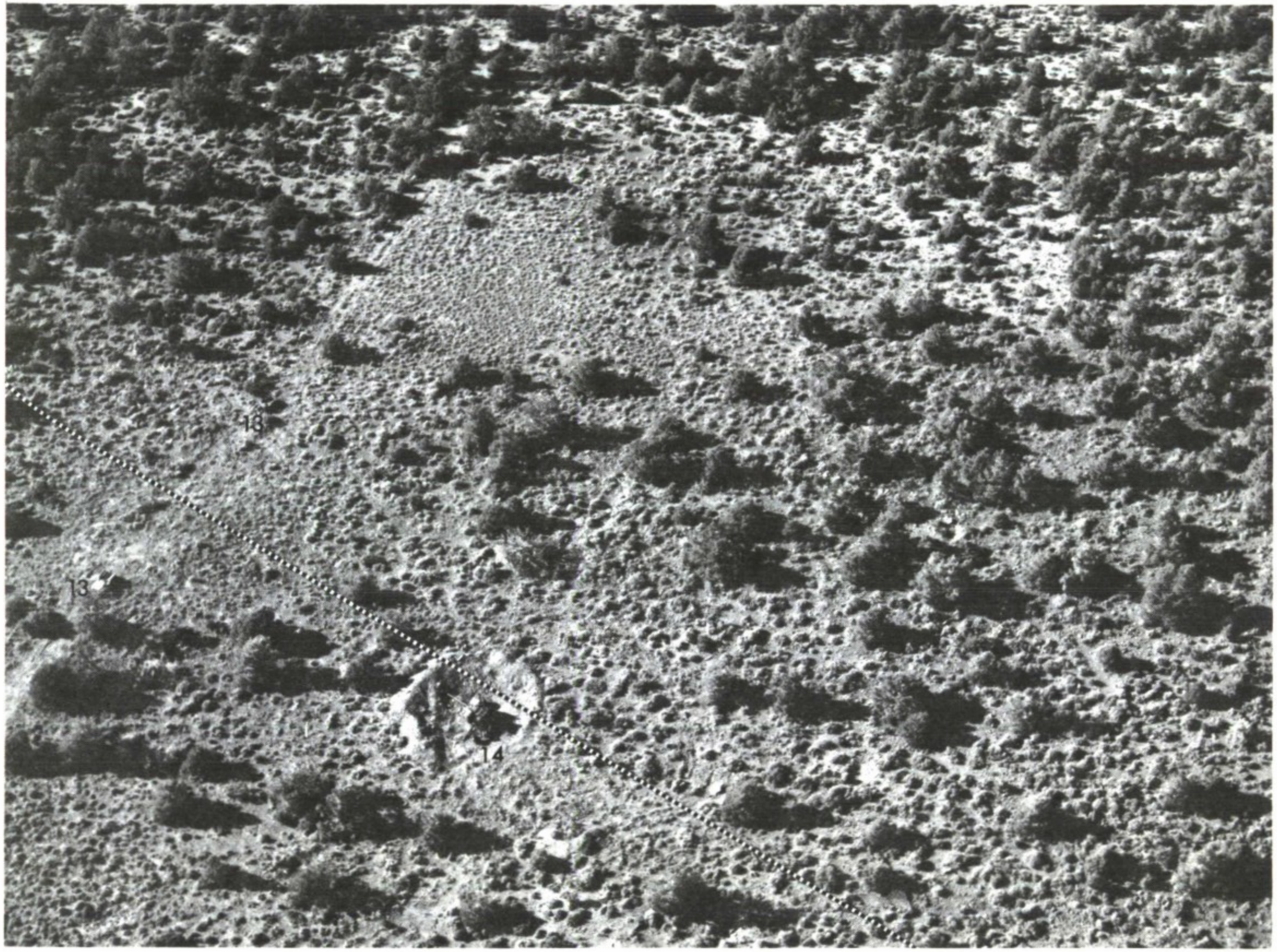


Fig. 2. TARGETS 14 AND 13 SEEN WHEN FLYING A 225^{O} LEG 1
(Approximate course indicated by dotted line.)

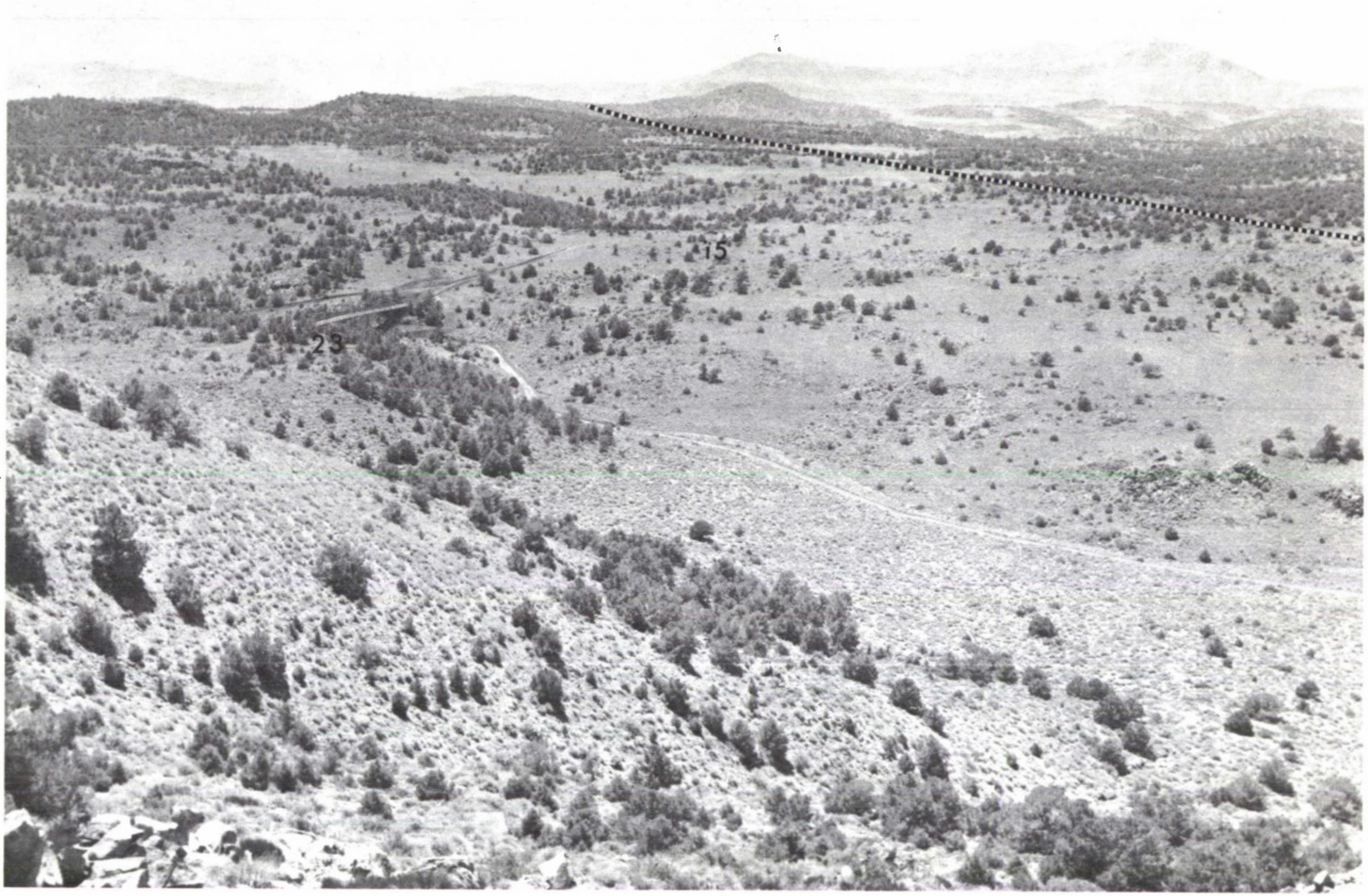


Fig. 3. TARGETS 23 AND 15 SEEN WHEN FLYING A 225° LEG 1
(Approximate course is indicated by dotted line.)

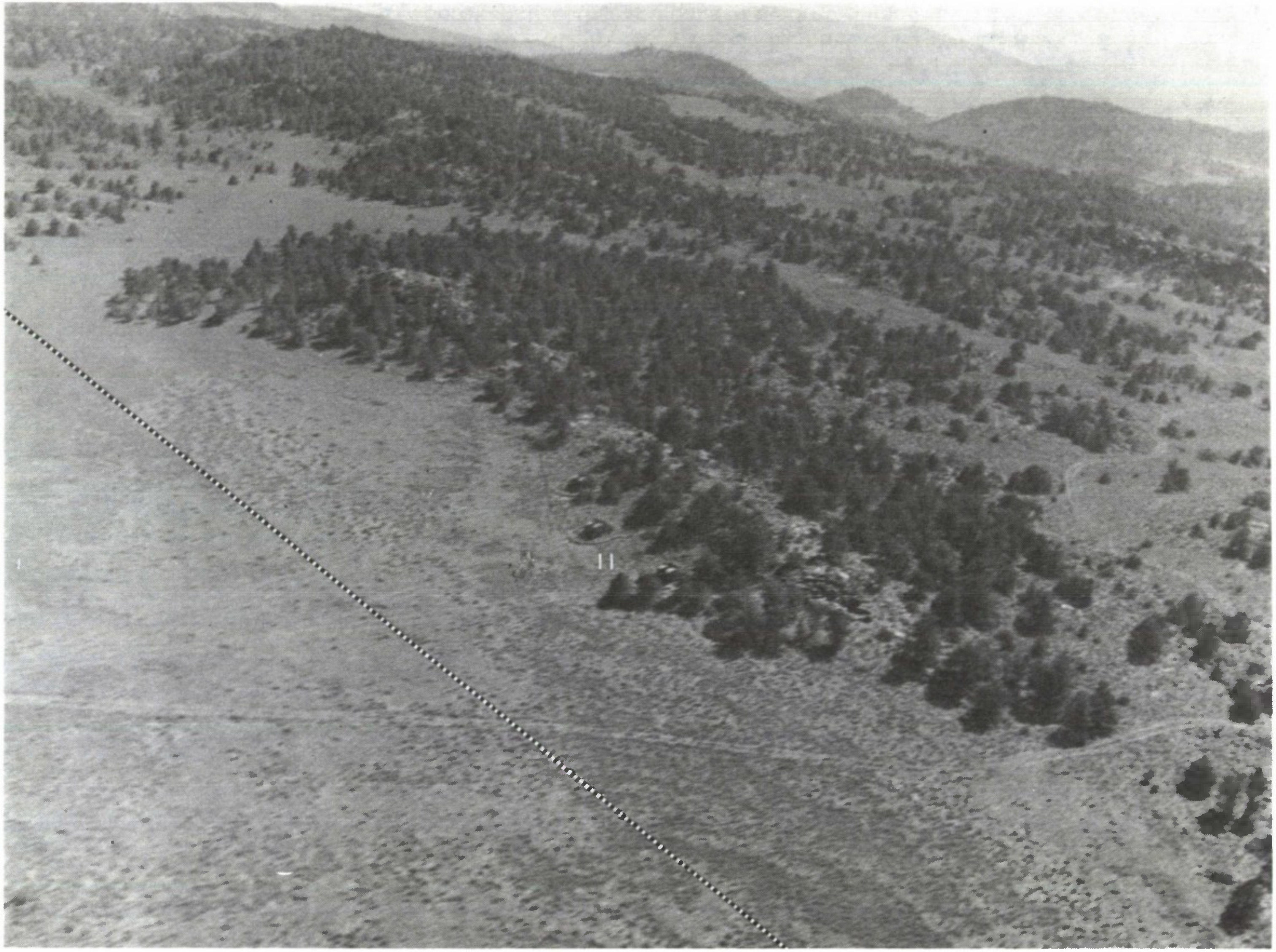


Fig. 4. TARGET 11 SEEN WHEN FLYING A 225^{O} LEG 1
(Approximate course is indicated by dotted line.)

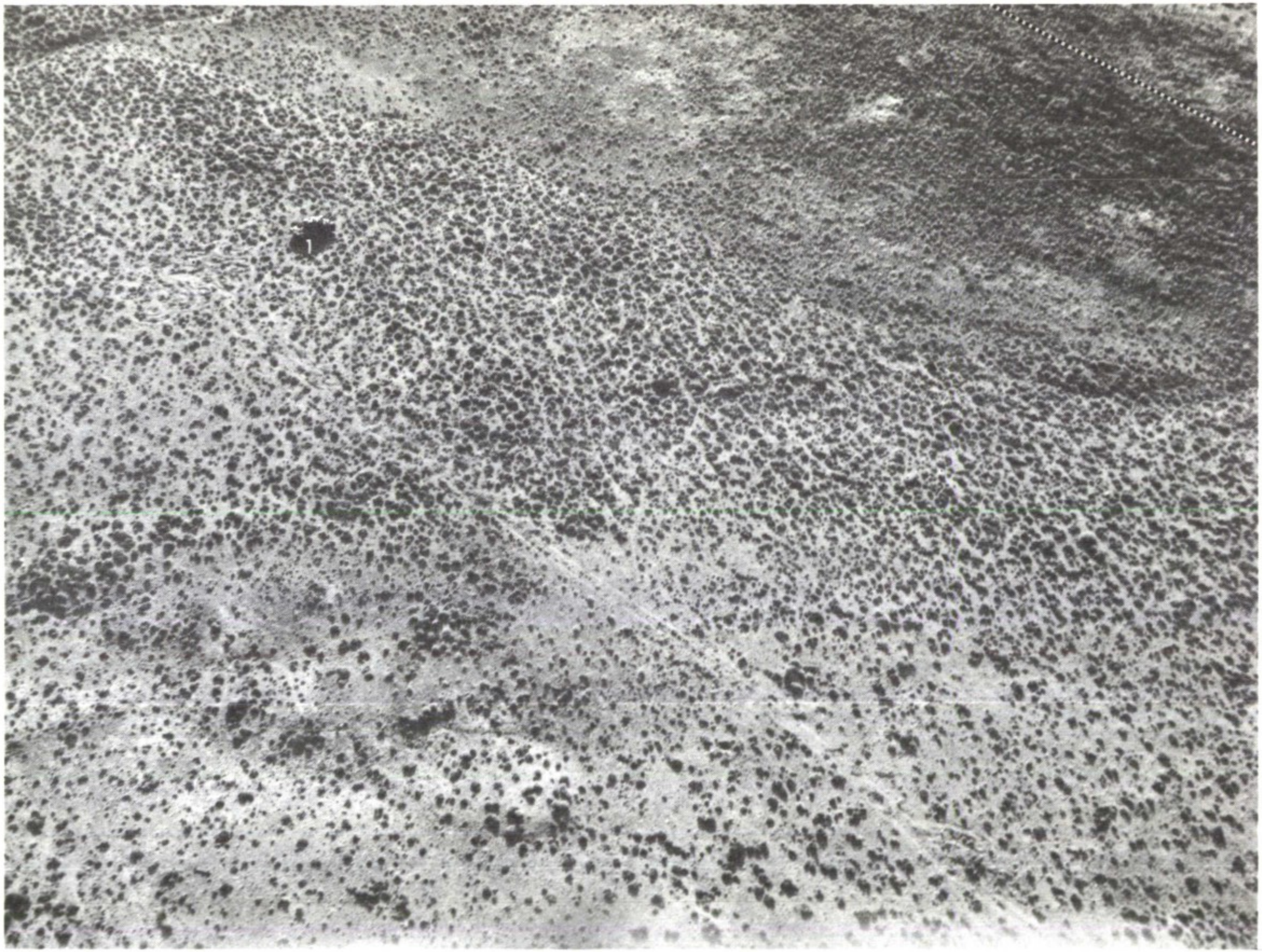


Fig. 5. TARGET 1 SEEN WHEN FLYING LEG 3
(Approximate course is indicated by dotted line.)

Fig. 6. TARGET 6 SEEN WHEN FLYING 045° LEG 3
(This target lies considerably to the right of the 045° course.)

Fig. 7. TARGET 2 FROM GROUND LEVEL
(These howitzers are to the left of the 045° Leg 3.)

Fig. 8. TARGETS SEEN WHEN FLYING 045° LEG 3
(Target 26 is a pickup truck which was not in place when this picture was made. Course is indicated by dotted line.)

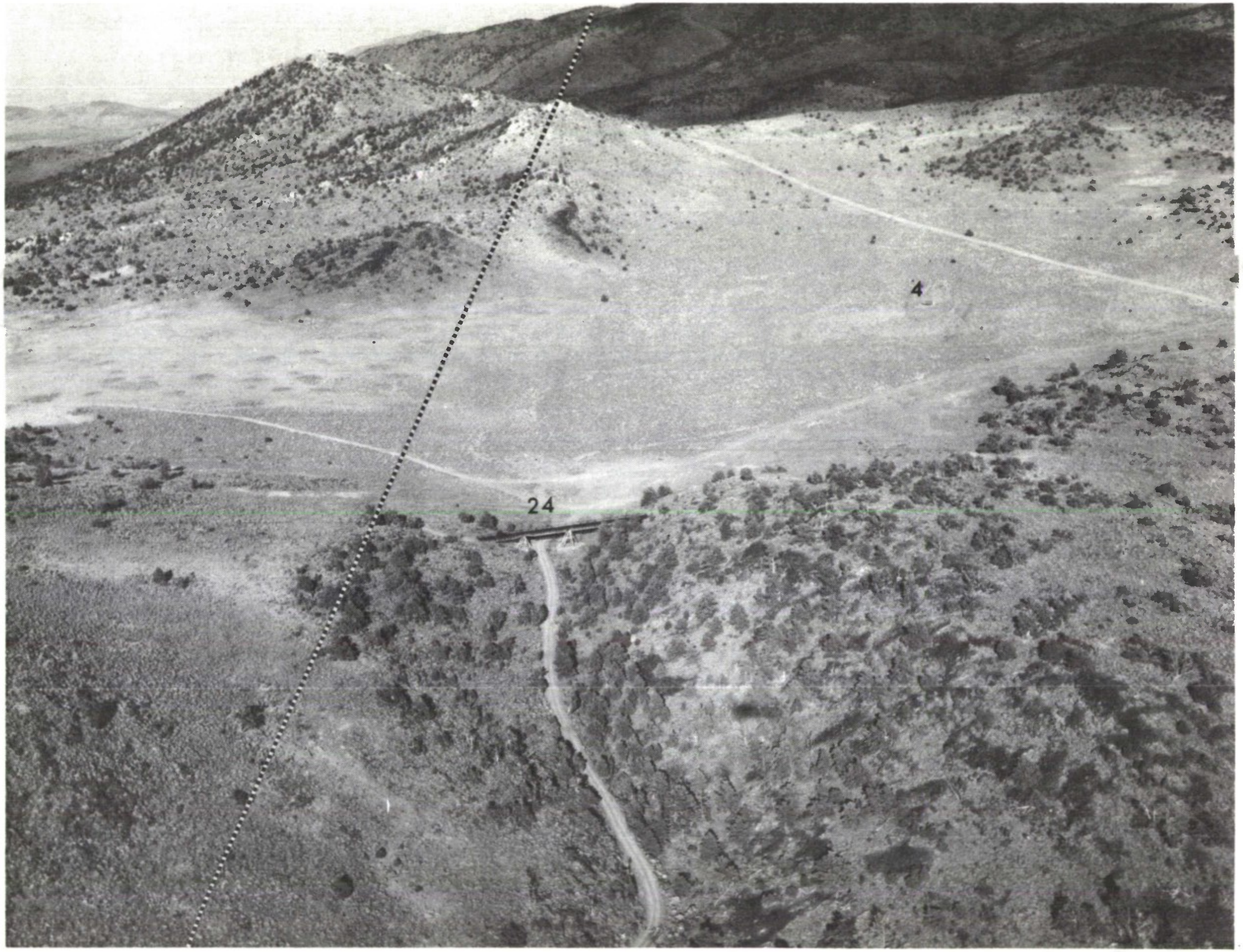


Fig. 9. TARGETS SEEN WHEN FLYING 045^{O} LEG 3
(Course is indicated by dotted line.)

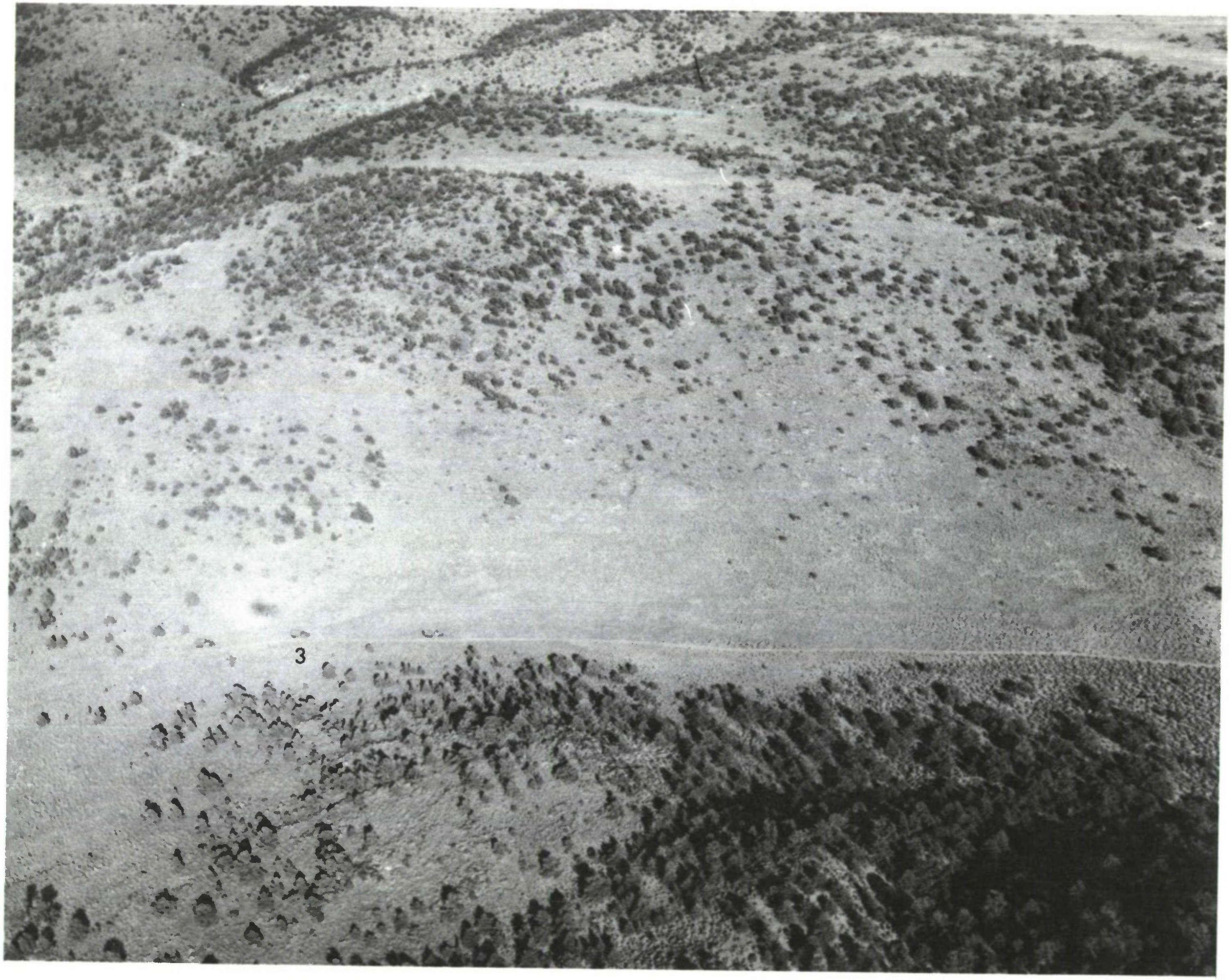


Fig. 10. TARGET 3, TRUCK CONVEY, SEEN WHEN FLYING 045° LEG 3 OR 225° LEG 2
(The course line for Leg 3 is to the left of the picture and Leg 2 is to the right of the picture.)

TABLE 1

List of Targets

Target Number	Type of Target	Heading	Latitude	Longitude	Elevation	Length	Width	Height	Number of Items
1	M-48 Tank	281°[a]	36°10'40"	117°47'12"	6716	24' 5"	12'	9' 10"	1
2	105MM Howitzer	261°	36°11'36"	117°46'35"	6843	19' 8"	7' 1"	5' 2"	3
3	M-211 Truck	156°	36°11'33"	117°45'21"	6970	22' 5"	8'	9' 4"	3
4	M-535 Shop Van	348°	36°11'12"	117°46'20"	6853	21' 4"	8'	9' 10"	c
5	90MM Gun-Mount	043°	36°10'55"	117°46'21"	6974	20' 10"	8' 5"	9' 4"	1
6	M-4 Tractor	186°	36°11'05"	117°46'09"	6866	17' 6"	8' 1"	9'	1
7	Bridge; 1 Lane	071°	36°10'54"	117°45'45"	6902	170'	16'	8'	1
8	Truck, Amphibious	211°	36°10'46"	117°45'19"	6900	31'	8' 3"	8' 10"	1
9	Trailer, Radar V-62	021°	36°11'06"	117°45'02"	6952	20' 2"	8' 2"	10' 5"	1
10	Trailer, Radar V-62	206°	36°10'58"	117°45'05"	6930	20' 2"	8' 2"	10' 5"	1
11	75MM Sky Sweep Gun	061°	36°11'29"	117°43'59"	7543	25' 5"	8' 6"	9'	3
12	Search Light	046°	36°11'59"	117°43'25"	7681	7' 10"	5'	7' 10"	3
13	Jeep; 1/4 T, 4 X 4	146°	36°11'45"	117°43'39"	7657	11' 7"	5' 1"	3'	2
14	75MM Sky Sweep Gun	271°	36°11'45"	117°43'37"	7658	25' 5"	8' 6"	9'	1
15	M-47 Tank	006°[a]	36°11'40"	117°43'30"	7624	23'	11' 7"	9' 10"	1
16	Trailer, Radar V-62[b]	126°	36°11'28"	117°43'46"	7591	20' 2"	8' 2"	17' 8"	1
17	Truck, Amphibious	196°	36°11'18"	117°43'40"	7536	31'	8' 3"	8' 10"	2
19	M-37 Truck	006°	36°11'36"	117°43'45"	7592	15' 4.75"	6' 1.5"	6' 1.5"	3
22	Supply Dump	066°	36°12'03"	117°43'38"	7704	---	---	---	d
23	Bridge; 2 Lane	081°	36°11'40"	117°43'20"	7592	228'	26'	25'[e]	1
24	Bridge; 1 Lane	121°	36°11'06"	117°46'42"	6850	160'	16'	40'[e]	1
26	Truck, Pickup (Chev)	261°	36°11'36"	117°46'37"	6834	16' 7"	6' 6"	6' 2"	1
27	Tractor and Tanker	226°	36°11'37"	117°43'46"	7592	42'	8' 2"	9' 1"	1

[a] Heading given is that of the gun in "Traveling Position".

[b] This radar van has a dish antenna; 6'2" L, 3'W, 7'3" H.

[c] There is also a T-33 fuselage and wing setting next to the van.

[d] This contains a M-211 Truck, 2 ea 8'x8'x10' huts, 2 ea 90MM guns, and numerous boxes. The heading given is that of the truck and is the general direction of the Supply Dump.

[e] This is height of bridge floor above terrain.

It was planned to have six observers tested under each of these conditions. In all cases, the first flights were made with the initial leg heading of 045° and the second flight was made with an initial leg heading of 225°.

The flight course consisted of three legs approximately three miles each in length with $045^{\circ}/225^{\circ}$ tracks. The terrain is very rugged (Fig. 11), with rapid changes in elevation. The course was to be flown at a height above the surface of 100 feet and a speed of 60 knots. The roughness of the terrain and the necessity of maintaining radar contact caused some variation in the altitudes and speeds actually flown.

The experiment was designed to take full advantage of the Target Detection/Identification Model Calculations developed for the Human Engineering Laboratory by Franklin and Whittenburg (1). Eight input variables were given for this model as:

1. Target size.
2. Target shape.
3. Target/ground brightness contrast.
4. Clutter.
5. Slant range.
6. Aircraft altitude.
7. Aircraft speed.
8. Terrain.

Most of the data on these input variables will be given in a follow-on report in which a Target Acquisition Model will be developed from the combination of the actual flight data from this experiment with the earlier Franklin and Whittenburg work.

It was planned to have six observers in each of the six flight order cells. Unfortunately, two of the test observers did not arrive in time for the flights due to an aircraft malfunction enroute and a misunderstanding of the flight schedule caused one cell to have seven observers. The actual experiment was as shown in Table 2.

TABLE 2

Experimental Order

Flight Order	Number of Subjects
1	6
2	6
3	5
4	5
5	7
6	5

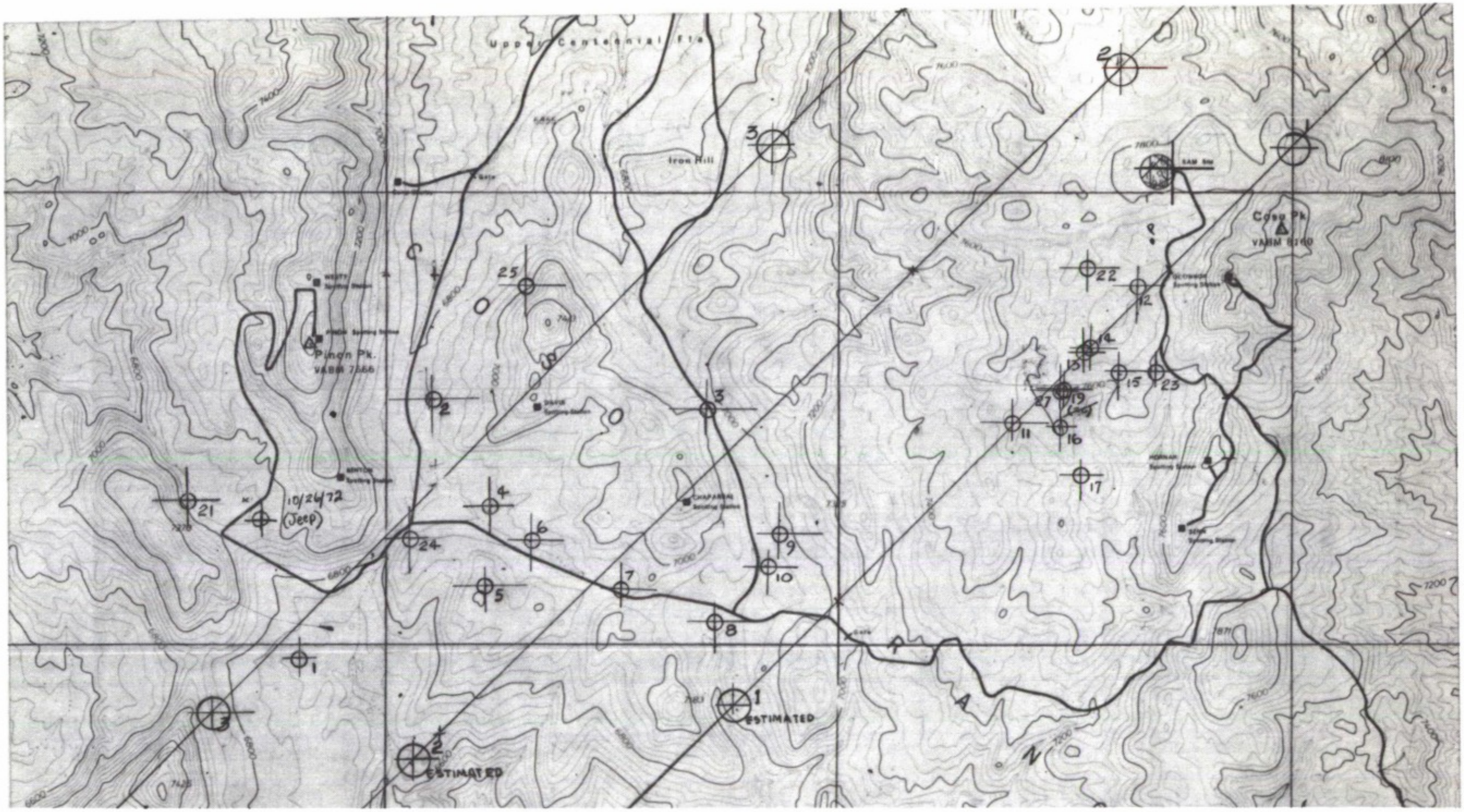


Fig. 11. HELHAT I FLIGHT TEST AREA WITH ANNOTATED TARGETS

RESULTS

The data from the flight tests were analyzed for two distinct conditions of target acquisition. The first analysis used all of the actual targets that were reported by the subject as the score for the run. The second used only those targets which were reported when within $\pm$ 080^{o} of the aircraft's heading and at a range of 100 meters or greater. The first condition would be valid for a route reconnaissance and the second for a seek and destroy mission. The actual scores of each observer for each of these conditions is given in Appendix B.

There were three data cells with only five scores, one with seven scores and two with the planned six scores. A preliminary analysis of the data indicated that the scores of the extra flight in Order 5 could be moved to Order 6 without changing the overall statistical value of these orders in the total analysis. The two cells, one from Order 3 and one from Order 4, were filled in using missing data techniques as outlined by Winer (3). With the experiment now in a factorial 6 x 6 format, an analysis of variance was performed using the form given as a Model II in Hays (2). the results are shown in Table 3.

TABLE 3

Analysis of Variance

Source	SS	df	MS	E	F
Order	26.7361	5	5.3472	5.461	.2791
Columns	97.5690	5	19.5138	5.819	1.0187
Interaction	478.8477	25	19.1539	5.461	3.7783
Error	182.5000	36	5.069	5.069	
Totals	785.6528	71			

The F value for the interaction term, significant at the .01 level, indicates that there is an observer-position/order of testing relationship which could be a learning effect for the second run. In order to investigate this possibility further, tests of the difference between means for the various testing conditions were conducted with the results shown in Table 4.

TABLE 4

Difference Between Means

Condition	Sigma	SD_d	t	$\overline{X}_1$	$\overline{X}_2$	Run
Front/Rear	3.7	1.4965	.334	18.6	19.1	1
Front/Left	2.99	1.22	1.56	18.6	20.5	1
Left/Rear	2.98	1.22	1.15	20.5	19.1	1
Front/Rear	2.36	.9636	.31	20.8	20.5	2
Front/Left	3.07	1.2528	1.916	20.8	23.2	2
Left/Rear	3.27	1.3328	2.026	23.2	20.5	2
Front	2.49	1.2199	.1.803	18.6	20.8	1/2
Left	3.11	1.2688	2.128	20.5	23.2	1/2
Rear	3.18	1.2961	1.08	19.1	20.5	1/2

The only relationship that was significant in Table 4 was that between the first and second runs in the left seat of the OH-58; this relationship was significant at the .05 level.

There also appears to be some relationship at a lesser level of confidence between the OH-58 position and the front and rear seat of the AH-1G, and it is quite obvious that the observer's position in the AH-1G does not affect his performance in that aircraft. In general, the observers in the OH-58 scored higher than those in the AH-1G when flying similar routes.

The data aove have been for all targets reported, regardless of their relative bearing and distance from the aircraft when reported. When the data were analyzed with the restriction that only targets within ± 080° of the aircraft heading and at a range of 100 meters or greater would be considered, the analysis of variance results were as shown in Table 5.

TABLE 5

Analysis of Variance — Restricted Scores

Source	SS	df	MS	E	F
Order	17.57	5	3.51	8.33	.35
Columns	20.57	5	4.11	8.33	.41
Interaction	312.35	25	12.49	8.33	1.52
Error	295.50	36	8.21	8.21	
Total	645.99	71	Pooled MS Error = 9.96		

There was no F value that was significant under these conditions. When the difference between the means was investigated several significant relationships appeared. Table 6 shows these relationships.

TABLE 6

Difference Between Means — Restricted Scores

Condition	Sigma	SD_d	t	$\bar{X}_1$	$\bar{X}_2$	Run
Front/Rear	2.41	.9843	0	15.0	15.0	1
Front/Left	1.99	.8111	2.979	15.0	17.4	1
Left/Rear	2.08	.8476	2.851	17.4	15.0	1
Front/Rear	2.91	1.1884	.981	19.1	17.9	2
Front/Left	3.60	1.4696	.737	19.1	20.1	2
Left/Rear	2.91	1.1884	.210	20.2	17.9	2
Front	2.94	1.1982	3.408	15.0	19.1	1/2
Left	2.88	1.1756	2.339	17.4	20.1	1/2
Rear	2.38	.9724	2.999	15.0	17.9	1/2

For the first run condition the scores obtained by the observers flying in the left seat of the OH-58 were significantly different, at the .01 level, from the scores obtained by the observers flying either seat of the AH-1G. The scores for the first and second runs in either seat of the AH-1G were significantly different at the .01 level, while those for the OH-58 were significantly different at the .05 level.

DISCUSSION

The results of this part of the experiment appear to provide a very definite answer about the observer's reconnaissance performance in a tandem seated helicopter: the observer can function equally well in either position so in future applications of this seating arrangement to combat type helicopters, the prime consideration should be the seating of the pilot in the position that is the most advantageous to him for the designed task of the aircraft.

The left seat position of the observer in the OH-58 seemed to be superior in all cases to either of the tandem positions; the difference was not significant for overall reconnaissance work but it was significant when the + 080^{o}/100 meter restriction was applied to the sightings. When the remaining data are analyzed to produce the predictor equation, it is felt that a definite reason for this apparent advantage will emerge. This test was conducted in terrain that made both flying and target detection quite difficult, so the results can be considered to be very conservative. An additional difficulty was the amount of ordnance debris along the test course. The range is used for gunnery as well as target detection, with the result that the debris ranges from spent cartridges to crashed aircraft and parts thereof. The mean clutter factor was 26 percent $\pm$ 2 percent for all the observer positions (Clutter Factor = 100 Percent - Actual Targets/Sightings) which indicates that all positions and all flights were affected about the same by the range debris.

REFERENCES

1. Franklin, M. E., & Whittenburg, J. A. Research on visual target detection, Part I, development of an air-to-gound detection/identification model. Human Sciences Research, Inc., McLean, Va., 1965.

2. Hayes, W. L. Statistics for psychologists. New York: Holt, Rinehart & Winston, 1963.

3. Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1971.

BIBLIOGRAPHY

Enderwick, T. P., Harris, R. T., & Havill, F. W., Jr. OCS low and high altitude target acquisition study. NR 72V-10, Missile Systems Division, North American Rockwell, Redstone Arsenal, Ala., 1972.

Moler, C. G. Helicopter armament program, air-to-ground target detection and identification. Technical Memorandum 1-62, Human Engineering Laboratories, Aberdeen Proving Ground, Md., 1962.

Whittenburg, J. A., Schreiber, A. L., & Richards, B. F. A field test, target discrimination and identification from the air. HumRRO, Fort Rucker, Ala., 1959.

Whittenburg, J. A., et al. Summary data from field tests of human aerial observer capability. HumRRO, Fort Rucker, Ala., 1959.

Whittenburg, J. A., Robinson, J. P., & Hesson, J. M. Aerial observer criterion field test manual. Human Sciences Research, Inc., Arlington, Va., 1959.

Whittenburg, J. A., Schreiber, A. L., Richards, B. F. Research on human aerial observation Part II, Description of tactical field test. HumRRO, Fort Rucker, Ala., 1960.

Whittenburg, J. A., et al. Research on human aerial observation, Part X, summary. HumRRO, Fort Rucker, Ala., 1960.

Zaitzeff, L. P. Target background scaling and its impact on the prediction of aircrew target acquisition performance. TR-D-180-14156-1, The Boeing Company, Seattle, Wash., 1971.

APPENDIX A

HELHAT I – TEST PLAN

GOAL

The goal of this study is to assess differences in target detection ability for pilot-observer teams in three distinct aircrew station arrangements (Fig. 1A): (1) the LOH side-by-side, (2) the COBRA tandem with pilot aft, and (3) the COBRA tandem with pilot forward.

There is some concern that the pilot/gunner arrangement in AAFSS and COBRA may be reversed from the optimum as far as mission performance is concerned. The basic logic is compelling in that in NOE flight the pilot's principal concern is forward and down, whereas the gunner-observers should be side-scanning. These primary visual tasks are not compatible with either the LOH side-by-side configuration or the COBRA/AAFSS gunner forward tandem configuration.

EXPERIMENTAL APPROACH

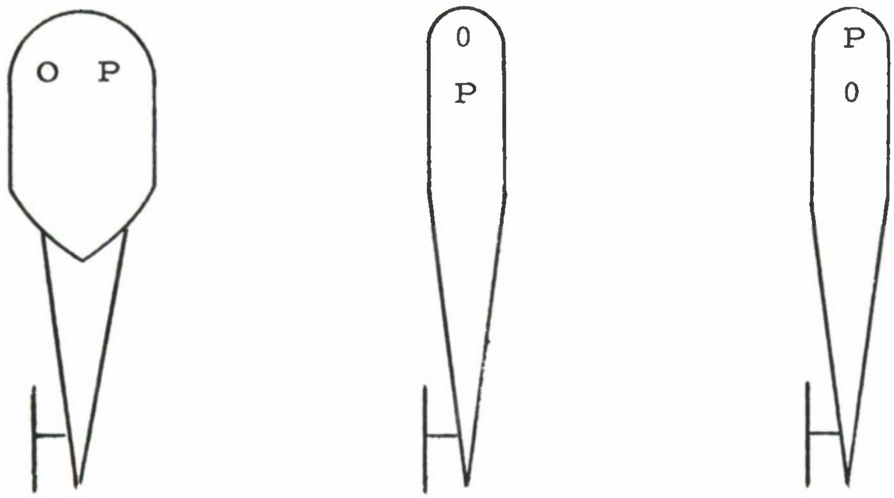
One of the primary concerns in developing a means of evaluating these configurations is maintaining simplicity in both approach and instrumentation. For the purposes of this study the three ingredients of which detection effectiveness is composed are (1) the number of targets detected, (2) the total time consumed on the task, and (3) the total time of exposure of the helicopter to the targets. The purpose of Number 1 is to score target detection. The purpose of Number 2 is to load the crew somewhat in time to avoid maneuvering and speeds which are ill-conceived from a tactically realistic point of view and to work in conjunction with element Number 3, which requires the pilots, necessarily trained and experienced in the scout role, to take maximum advantage of this training and experience in the study.

The flight crews will know that these are the things being measured and they will be competing for a good score. They will not know we are examining the merits of the three configurations in order to eliminate any personal bias they might have. No crew will fly more than one of these configurations and a time spread will be built in-between testing of each configuration to insure isolation among these elements.

No attempt will be made to use military targets. The nature of targets planned is such as to eliminate any requirements for sensing or discriminating any target stimuli at or near threshold values. This test is not for aircrew vision as such, it is to seek out the magnitude and direction of differences in detection that are or may be associated with overall cockpit configuration/crew arrangement. Our basic hypothesis is that Pilot Front-Observer Rear will surpass both Observer Front-Pilot Rear and Side by Side by nature of its proper division of primary visual areas of concern.

AIRCRAFT

LOH | COBRA 1 | COBRA 2



CONFIGURATION

LOH	COBRA 1	COBRA 2
Pilot Right	Observer Front	Pilot Front
Observer Left	Pilot Rear	Observer Rear

P - Pilot

O - Observer

Fig. 1A. EXPERIMENTAL CONFIGURATIONS

The six targets (Fig. 2A) that will be used can be clearly identified by symbols rather than alphanumerics.

These targets will be executed in high visibility colors, black on yellow, and will measure 4 x 8 feet. They will be set along a course utilizing the Aberdeen Proving Ground test area. The flight plan will be a route reconnaissance closely following test roads and taking advantage of the terrain in that area. Only one target will be capable of being seen at a time. Flight time over the course will be 20 minutes. When either of the flight crew spots a target, he will immediately press the detection response button and announce the target symbol over the radio.

The aircraft will be equipped with three 16mm motion picture cameras which will provide a complete record of the aircraft's flight path during the run. An event marker light will go on when the crew depresses the detection response button and will stay on some two seconds. The appearance of this light on the tracking film is the fiducia for the point of detection, the exposure time is derived from a simple frame count of the tracking film. Many elaborations are possible but the three essential measures--(1) total time, (2) exposure and (3) number of detections--can be derived from the data yielded by this scheme.

There will also be a syncronizing light mark provided on the film at random times so that the film from the three cameras output can be viewed in proper alignment.

The essential points of HELHAT I are:

1. The importance of crew arrangement, its interaction with vision areas, hence mission.

2. The importance of crew arrangement as it affects the basic configuration of the aircraft.

3. The importance of target detection on overall play of the engagement sequence.

METHOD

HELHAT I will be sensitive to seasonal weather conditions and therefore the work flow as shown on the Schedule of Events (Fig. 3A) is critical.

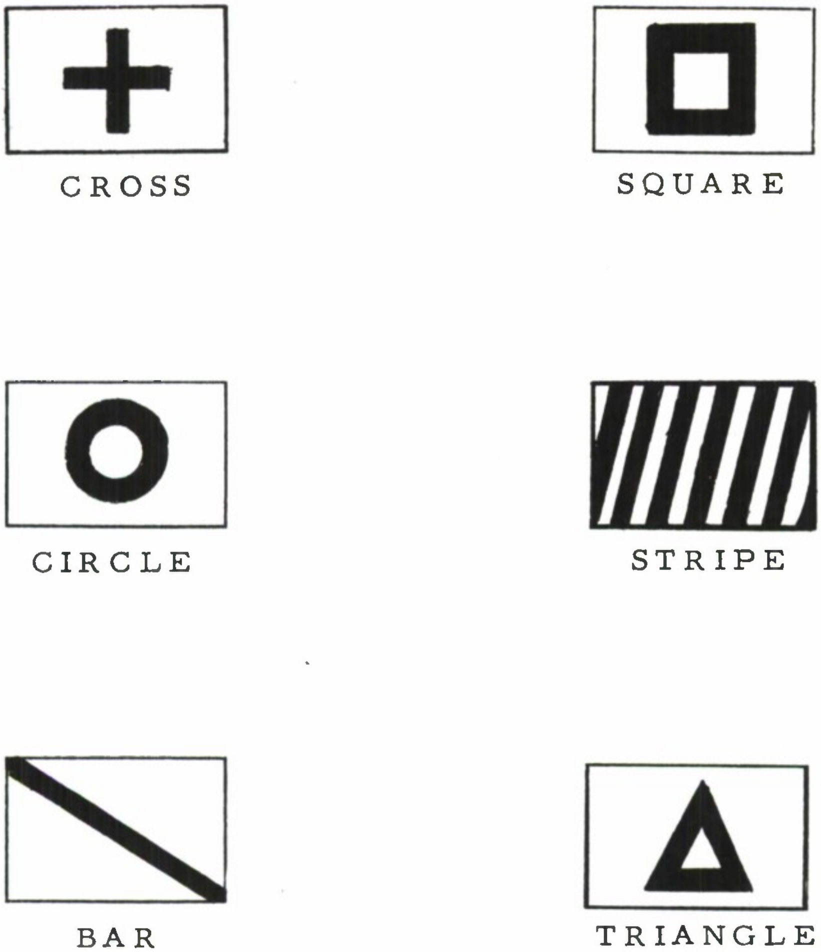


Fig. 2A. HELHAT TARGETS

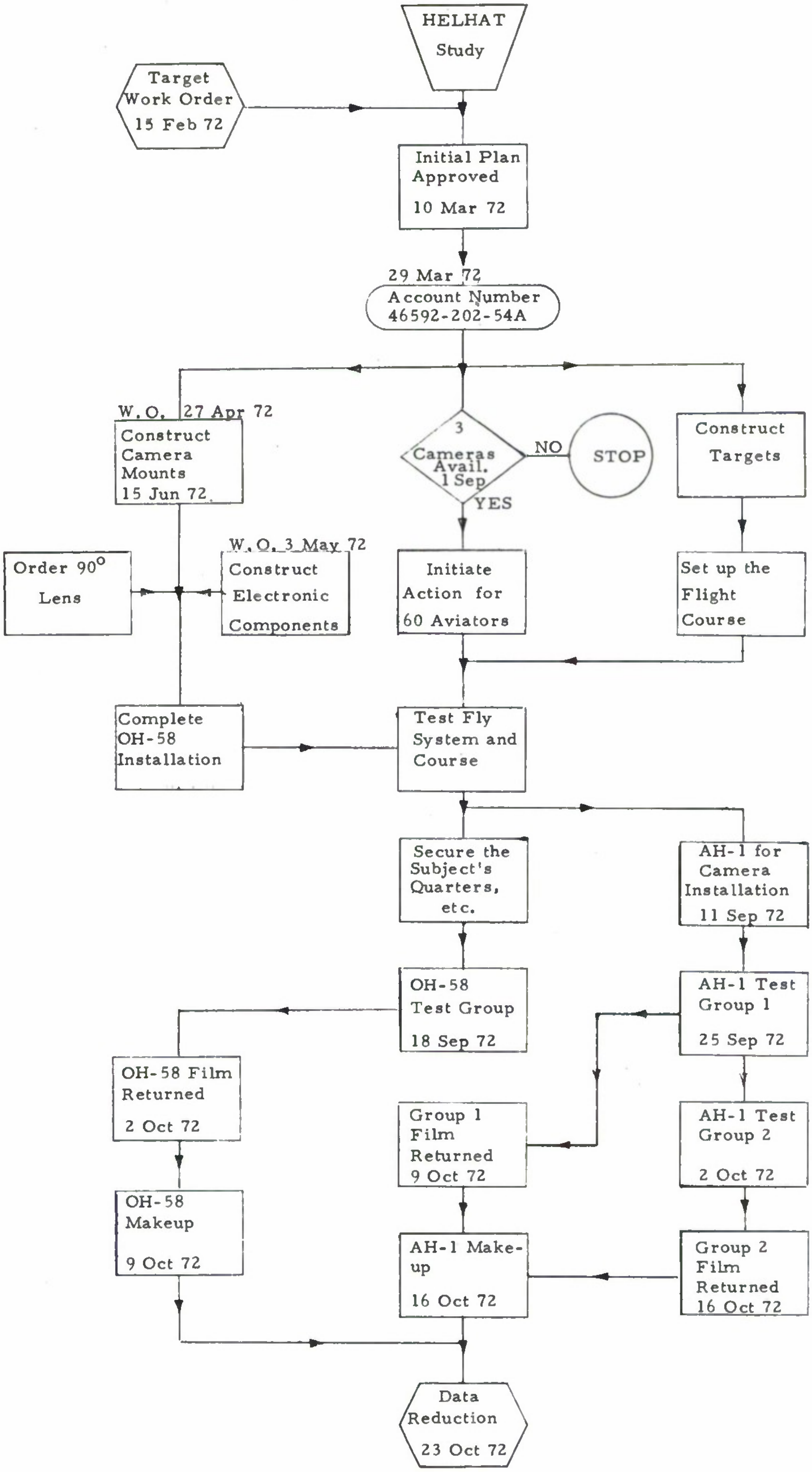


Fig. 3A. SCHEDULE OF EVENTS

EXPERIMENTAL DESIGN

The experiment is designed to take full advantage of the Target Detection/Identification Model Calculations developed by Franklin and Whittenburg (1). Eight input variables are given for this model:

1. Target size.
2. Target shape.
3. Target/ground brightness contrast.
4. Clutter
5. Slant range.
6. Aircraft altitude.
7. Aircraft speed.
8. Terrain type.

HELHAT I will keep Variables 1, 2, 6, 7 and 8 constant and will attempt, by proper course design, to keep Variables 3 and 4 constant. This plan will enable us to use the slant range at which the targets were detected as one of the scoring measures. The other scoring measure will be the value in seconds of $S_s - S_c$ where S_s is the time the crew reported seeing the target and S_c is the time the target was available for sighting.

The three aircraft mounted cameras will provide a continuous film record of each flight and will enable the Data Reduction Team to determine when the target first was available for sighting, the actual time and position when the target was sighted, and the aircraft's path over the test area.

The targets in the test area will be set such that two targets will be to the left of the desired flight path, two will be to the right, and two will be on the flight path.

Franklin and Whittenburg (1) provide a detailed description of test model and the calculations involved.

The use of 10 crews for each test condition is dictated by the calculation for the minimum value for n where a normal distribution is assumed. This is given as $n(1-x) = 5$, thus, for a normal distribution where $x = .5$, we have:

$$n(1-.5) = 5$$

$$.5n = 5$$

$$n = 10 \text{ the minimum value.}$$

The experiment is made up of three conditions:

1. Pilot right side, observer left side;

2. Pilot aft, observer forward;

3. Pilot forward, observer aft.

There are six equal sized targets and 10 different crews' trials on each target under each condition.

This design will allow several types of statistical analyses to be performed on the data, ranging from simple mean values through analysis of variance.

Phillips Army Airfield is in a good position to support the HELHAT tests. Preliminary planning as regards the setup of flight routes (Fig. 4A) and target locations has been initiated. Detailed planning of scout scenarios will include support of combat-experienced scout aviators to account for some of the techniques of this highly-specialized kind of flying. If flights and target arrangements are not carefully worked out, a great deal of data could be lost because of lack of intervisibility. It is important to consider the requirements for the future HELHAT studies and to plan target areas that will allow free-fire gunnery and permanent target locations for the follow-on work.

AIRCRAFT REQUIREMENTS

The test will require a minimum of two aircraft. One will be an LOH, either an OH-6 or OH-58, and the other will be an AH-1. The AMC Aviation Office does not foresee any difficulty in providing a COBRA during August, September and October, although they are in short supply. The side-by-side aircraft can be provided by Phillips Army Airfield in the form of one of their OH-58As. The aircraft will be flown for one hour by each subject crew, therefore the LOH (OH-58) will be flown for 10 hours and the AH-1 will be flown 20 hours. There will also be a requirement for an aircraft to fly the pilot study when the course is set up. It appears that a planning allowance of 10 flight hours should be ample for these tasks. The total flight hours required are 40: 20 hours in the AH-1, 10 in the OH-58 and the remaining 10 probably also in the OH-58.

CAMERA REQUIREMENTS

The study will require the airborne cameras to have a low frame rate 20 minute film run-time and be of minimum weight. The present "on hand" cameras do not possess this capability. The DBM-4C versions of the Milliken can be fitted with standard Milliken motors which allow frame rates of 4, 6, 8 and 12 frames per second with no ancillary equipment, such as pulsing devices, etc., needed. The cost of these motors is approximately $300 per unit and they are a standard, off-the-shelf item which adds no extra weight to the camera. These motors will provide the desired film run-time, with no complicated setting procedure, and they are not sensitive to voltage fluctuation as are the infinite speed adjust cameras. The study, as now planned, will use three such cameras on the aircraft.

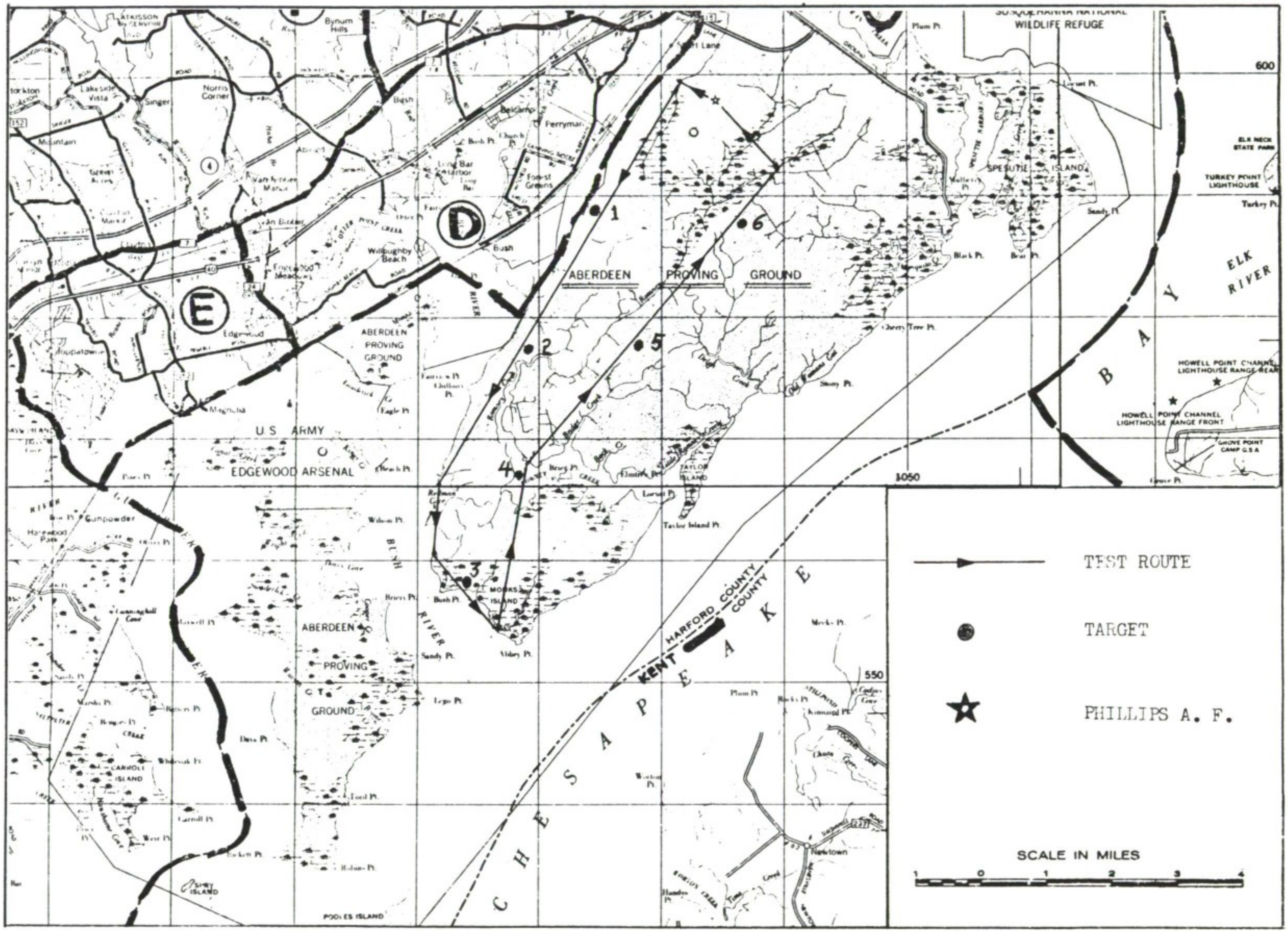


Fig. 4A. HELHAT FLIGHT ROUTE AND TARGET POSITIONS

MANPOWER REQUIREMENTS

The Aviation Team has two members assigned full time to this project to design the test plan and to conduct the test. In addition, this test will require 10 combat-ready OH-58 scout pilots, 10 combat-ready scout observers, 10 combat-ready AH-1 pilots, 10 combat-ready front seat qualified/experienced AH-1 pilots and 20 combat-ready AH-1 scout observer/pilots. These 60 airmen are required in order to perform the 10 test runs in each of the three crew configurations being compared. There are no pilots available at Aberdeen Proving Ground who qualify as subject pilots or observers.

SUPPORT REQUIREMENTS

Any test of this magnitude requires support from the total organization sponsoring the test, and HELHAT I does require this support. In fact, it requires this support on schedule or the cost of the test will become excessive and the possible loss of the use of the aircraft, especially the AH-1, becomes a distinct possibility if the in-house support is not provided in such a manner that the Schedule of Events, Figure 3A, can be met. The critical in-house support required is as follows:

1. Construction of the six targets with a delivery time of 1 May 1972.

2. Design and construction of three Milliken camera mounts to fit the OH-58 with a delivery date of 1 July 1972.

3. Design and construction of three Milliken camera mounts to fit the AH-1 with a delivery date of 1 September 1972.

4. Overhauling of one DMB-4C Milliken camera electronics system with a delivery date of 1 July 1972.

5. Design and fabrication of the pulsing switch, event marker, camera syncro device and the interface cabling for the OH-58 aircraft/camera system with a delivery date of 1 July 1972.

6. Design and fabrication of the pulsing switch, event marker, camera syncro device and the interface cabling for the AH-1 aircraft/camera system with a delivery date of 1 September 1972.

7. Securing of two 90° wide angle lenses, and 12,000 feet color film, with a delivery date of 15 August 1972.

The procurement of three slow speed motors for the cameras would eliminate items 4, 5 and 6. These items are the major scheduled support needed for the HELHAT I test. In addition, some men will be needed to initially transport and set the six targets; some sort of target covers will be needed; test film will have to be processed and returned within a 14-day period so that makeup flights, if necessary, can be scheduled; and some help may be needed from the Photography Laboratory on the days the actual testing is accomplished to insure complete and efficient utilization of the cameras.

The targets to be used have been designed for the late summer season when the trees and bushes are in full leaf and the weather is fairly stable. This allows the period of 1 May through 20 October to set up the course, run the pilot experiment, and complete data collection. To meet this schedule, Table 1A, it is imperative that the study have sufficient priority to allow completion of all work orders submitted in accordance with the Schedule of Events.

TABLE 1A

Experiment Schedule

Month	Event
March - April	Develop detailed flight scenarios utilizing CPT Furman and others. Fly the various areas and routes to select target position and approach options.
May-June	Visit CDEC, TRICAP and other field testing centers to discuss scenario development, long range test integration requirements, future utilization of VIPOR and various sources of subjects. Write up results and findings.
July	Test setup and installation.
August - September	Run HELHAT Phase I and modify camera mounts for AH-1.
October	Allow for weather and slippage (built in hold).
November, December, January	Analyze data and report findings.

SCENARIO

All crews will be given a map briefing that will contain the following situation:

Intelligence reports that the enemy is prepared to cross Bush River momentarily in an effort to capture this airfield. The enemy may have already covertly crossed the river and emplaced several of their new PM weapons along the shoreline between Pond Point and Abbey Point and along the two roads leading to the airfield. The commander wants an immediate route reconnaissance made of the roads and shoreline so that any of these weapons found can be destroyed within the next 30 minutes. The enemy has radar-controlled guns along the south shore of Bush River so your flight altitude will have to be below 100 feet. Previous flights in the area report wires and obstructions to a height of 50 feet so this is your safe minimum altitude. It is necessary to have your report within the next 30 minutes.

The crew will then go to the aircraft, start up, and fly the mission. They will have approximately 20 minutes left in which to complete the flight in order to meet the 30 minute time allowed.

TARGET PLACEMENT

The targets (Fig. 2A) have an area of 21 square feet and a volume of 16 cubic feet; therefore, careful consideration has to be given to the placement of these targets. Previous work in target identification from low flying aircraft has provided us with the square mil formulation which provides a mathematical method to determine the angle at which the targets should be elevated to provide equal size presentations to the flight crews at any given orthogonal position and slant range. The six targets will be spaced alogn the course so that the mean time between targets will be 150 seconds. They will be painted a fluorescent yellow with a black identifying figure. The targets will be set in the wooded areas in such a manner that they will be visible during the aircraft's approach, but cannot be seen once the aircraft has passed a given bearing.

FUNDING REQUIREMENTS

Aircraft utilization (PAAF) (operation, service and maintenance)	$18,000
Subjects (travel and per diem) ($5,000 more if billeted off-post)	10,620
Slow speed motors for Milliken cameras	900
Targets and racks	500
16mm film and processing	1,200
Preliminary flight work and pilot study — to PAAF	5,000
Airborne event recorder	GFE
Target placement	GFE
	$36,220

TABLE 2A

Summary of Support Requirements for Field Test

Item	Unit
Aircraft	1 OH-6 or OH-58, 1 AH-1
Pilots	10 LOH, 20 AH-1
Observers	10 LOH, 20 AH-1
Targets	6
Cameras	3
Camera Mounts	3 LOH, 3 AH-1
Wide Angle Lenses	3
Pulse Device*	1
Wiring Harness	1 LOH, 1 AH-1
Film, Color	120 100-foot rools (12,000 ft.)
Target Placement Crew	2-man crew with vehicle for 2 man weeks
Target Supports	500 board feet of 2 x 4 lumber
Photographer	1 man week
Flight Time	20 hours LOH, 20 hours AH-1

*Delete if slow speed camera motors are used.

APPENDIX B

EXPERIMENT DATA

Group One: AH-1G; Flight one, front seat; Flight two, rear seat.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
2	2	0955	20	33	49	1520	22	12
5	6	1058	17	26	9	0924	19	17
21	15	1330	20	29	17	1404	24	25
24	18	1428	18	22	62	1042	19	27
27	21	1604	16	27	50	0940	15	16
33	51	1018	21	25	37	1402	22	33

Group Two: AH-1G; Flight one, rear seat; Flight two, front seat.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
7	8	1125	14	30	63	1116	20	31
12	29	1019	23	28	68	1408	25	40
36	53	1100	13	32	46	1604	20	37
39	56	1232	20	13	40	1457	21	19
42	34	1312	21	43	66	1258	24	25
50	44	1537	21	22	60	1022	21	32

Group Three: Flight one, OH-58; Flight two, rear seat, AH-1G.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
22	16	1343	21	19	32	1244	18	14
25	19	1449	23	32	35	1324	22	31
1	1	0937	20	17	59	1005	19	17
13	30	1033	21	25	72	1340	21	32
18	12	1238	17	35	69	1310	24	25

Group Four: Flight one, OH-58; Flight two, front seat, AH-1G.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
6	7	1110	19	32	13	1254	20	33
10	27	0942	18	14	10	1204	21	16
38	45	1205	24	17	57	0918	17	37
35	54	1045	23	18	39	1414	19	34
41	33	1257	18	28	65	1229	21	22

Group Five: Flight one, front seat, AH-1G; Flight two, OH-58.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
3	3	1010	14	26	43	0854	16	36
8	25	0901	13	0	9	1144	20	29
11	28	0958	15	29	61	1055	22	24
26	20	1502	25	61	64	1128	28	66
30	49	0912	22	4	42	1549	28	15
34	52	1032	22	18	38	1442	24	20
15	4A	1112	24	20	68	1243	27	21

Group Six: Flight one, rear seat, AH-1G; Flight two, OH-58.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
4	5	1106	14	0	58	0952	19	14
14	31	1050	19	41	70	1356	25	37
20	14	1317	18	14	47	0954	21	19
28	22	1531	20	26	36	1347	26	23
37	55	1112	22	29	48	1617	22	29

DAILY FLIGHT ORDER

24 October		25 October		26 October		27 October	
#	Time	#	Time	#	Time	#	Time
1	0937	25	0901	43	0854	57	0918
2	0955	26	0924	49	0912	58	0952
3	1010	27	0942	50	0940	59	1005
5	1106	28	0958	47	0954	60	1022
6	1058	29	1019	51	1018	62	1042
7	1110	30	1033	52	1032	61	1055
8	1125	31	1050	54	1045	63	1116
		4A	1112	53	1100	64	1128
		9	1144	55	1112	65	1229
		10	1204	45	1205	68	1243
		12	1238	56	1232	66	1258
		13	1254	32	1244	69	1310
		14	1317	33	1257	72	1340
		15	1330	34	1312	70	1356
		16	1343	35	1324	71	1408
		17	1404	36	1347		
		18	1428	37	1402		
		19	1449	39	1414		
		20	1502	38	1442		
		21	1604	40	1457		
		22	1531	41	1520		
				44	1537		
				42	1549		
				46	1604		
				48	1617		

METEROLOGICAL CONDITIONS

24 October 1972: Clear to scattered at end of period; wind 10 to 15 K

25 October 1972: Clear; wind 24K to 4K at end of period

26 October 1972: Clear to scattered; wind L/V; wind 15K at end of period

27 October 1972: Scattered to overcast at end of period; wind L/V.

APPENDIX C

CALCULATIONS

Analysis of Variance. All Target Sightings

ORDER	1	2	3	4	5	6	sum	SUM
Front	20	17	20	18	16	21	112	
Rear	22	19	24	19	15	22	121	
sum	42	36	44	37	31	43		233
Rear	14	23	13	20	21	21	112	
Front	20	25	20	21	24	21	131	
sum	34	48	33	41	45	42		243
Left	19	18	24	18	23	21*	123	
Front	20	21	17	21	19	21*	119	
sum	39	39	41	39	42	42		242
Front	14	13	15	25	22	22	111	
Left	16	20	22	28	28	24	138	
sum	30	33	37	53	50	46		249
Rear	14	19	24**	18	20	22	117	
Left	19	25	27	21	26	22	140	
sum	33	44	51	39	46	44		257
Left	20	21	17	21	23	21*	123	
Rear	19	21	24	18	22	20*	124	
sum	39	42	41	39	45	41		247
TOTALS	217	242	247	248	259	258		1471

Correction Term = 30053.347
Sum of Squares Total - 30839 - C.T. = 785.653
Sum of Squares Rows = 360961/12 - C.T. = 26.736
Sum of Squares Columns = 361811/12 - C.T. = 97.569
Sum of Squares Error = 30839 - 61313/2 = 182.500
Interaction = 785.653 = (26.736 + 97.569 + 182.5) = 478.848

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* Missing data technique applied to fill cell
** Moved data

Analysis of Variance. All Targets $\pm$ 080° of Heading and Range 100 Meters

ORDER	1	2	3	4	5	6	sum	SUM
Front	13	16	17	15	14	17	92	
Rear	20	16	20	18	14	19	107	
sum	33	32	37	33	28	36		199
Rear	13	17	12	15	16	16	89	
Front	19	24	15	20	22	16	116	
sum	32	41	27	35	38	32		205
Left	17	18	18	18	15	17*	103	
Front	19	14	15	14	18	19*	99	
sum	36	32	33	32	33	36		202
Front	12	11	14	19	15	17	88	
Left	15	18	19	24	27	17	120	
sum	27	29	33	43	42	34		208
Rear	14	14	20**	12	18	13	91	
Left	18	21	26	18	25	17	125	
sum	32	35	46	30	43	30		216
Left	17	20	15	20	17	17*	106	
Rear	19	18	21	16	15	18*	107	
sum	36	38	36	36	32	35		213
TOTALS	196	207	212	209	216	203		1243

Correction Term = 21459.01
Sum of Squares Total = 22105 - C.T. = 645.99
Sum of Squares Rows = 21476.58 - C.T. = 17.57
Sum of Squares Columns = 21479.58 - C.T. = 20.57
Sum of Squares Error = 22105 - 43619/2 = 295.50
Interaction = 645.99 - (17.57 + 20.57 + 295.50) = 312.35

*Missing data technique applied to fill cell.
**Moved data

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13. ABSTRACT

A flight experiment was performed to determine the effect of the observer's position in the helicopter on his ability to detect ordnance targets. The positions tested were: left seat, front seat and rear seat.

The 34 U. S. Army pilot subjects each flew two trial flights in opposite directions over a three-leg course at Coso Military Target Range, Naval Weapons Center, China Lake, California.

The results of the experiment showed no significant target detection performance differences that could be attributed to the observer's position in the helicopter.

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